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EPA A Citizen's Guide To Soil Washing

Technology Innovation Office _____ **Technology Fact Sheet**

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What Is Soil Washing?

Soil washing is a technology that uses liquids (sometimes combined with chemical additives) and a mechanical process to scrub soils. This scrubbing removes hazardous contaminants and concentrates them into a smaller volume. Hazardous contaminants tend to bind, chemically or physically, to silt and clay. Silt and clay, in turn, bind to sand and gravel particles. After the soil washing process is completed, the smaller volume of soil, which contains the majority of the fine silt and clay particles, can be further treated by other methods (such as incineration or bioremediation) or disposed of according to State and Federal regulations. The clean, larger volume of soil is not toxic and can be used as backfill.

How Does Soil Washing Work?

A simplified drawing of the soil washing process is illustrated in Figure 1 on page 2. The process begins by digging up the contaminated soil and moving it to a staging area — a place where contaminated material is prepared for treatment. The soil is then sifted to remove debris and large objects, such as rocks. The remaining material enters a soil scrubbing unit, in which the soil is mixed with a washing solution and agitated. The washing solution may be simply water or may contain additives, like detergent, which remove the contaminants from the soil. This process is very similar to washing laundry. The washwater is drained out of the soil scrubbing unit, and

Soil Washing Profile

- **Separates fine-grained particles (silt and clay) from coarse-grained particles (sand and gravel).**
- **Significantly reduces the volume of contaminated soil.**
- **Is a relatively low-cost alternative for separating waste and minimizing volume required for subsequent treatment.**
- **Is a transportable technology that can be brought to the site.**

the soil is rinsed with clean water.
The heavier sand and gravel particles in the processed soil settle out and are tested for contaminants. If clean, this material can be used on the site or taken elsewhere for backfill. If contaminated, the material may be run through the soil washing process again, or collected for alternate treatment or off-site disposal. Off-site disposal is regulated by the Resource Conservation Recovery Act (RCRA) or the Toxic Substance Control Act (TSCA) and, therefore, a permitted RCRA or TSCA landfill must be used.

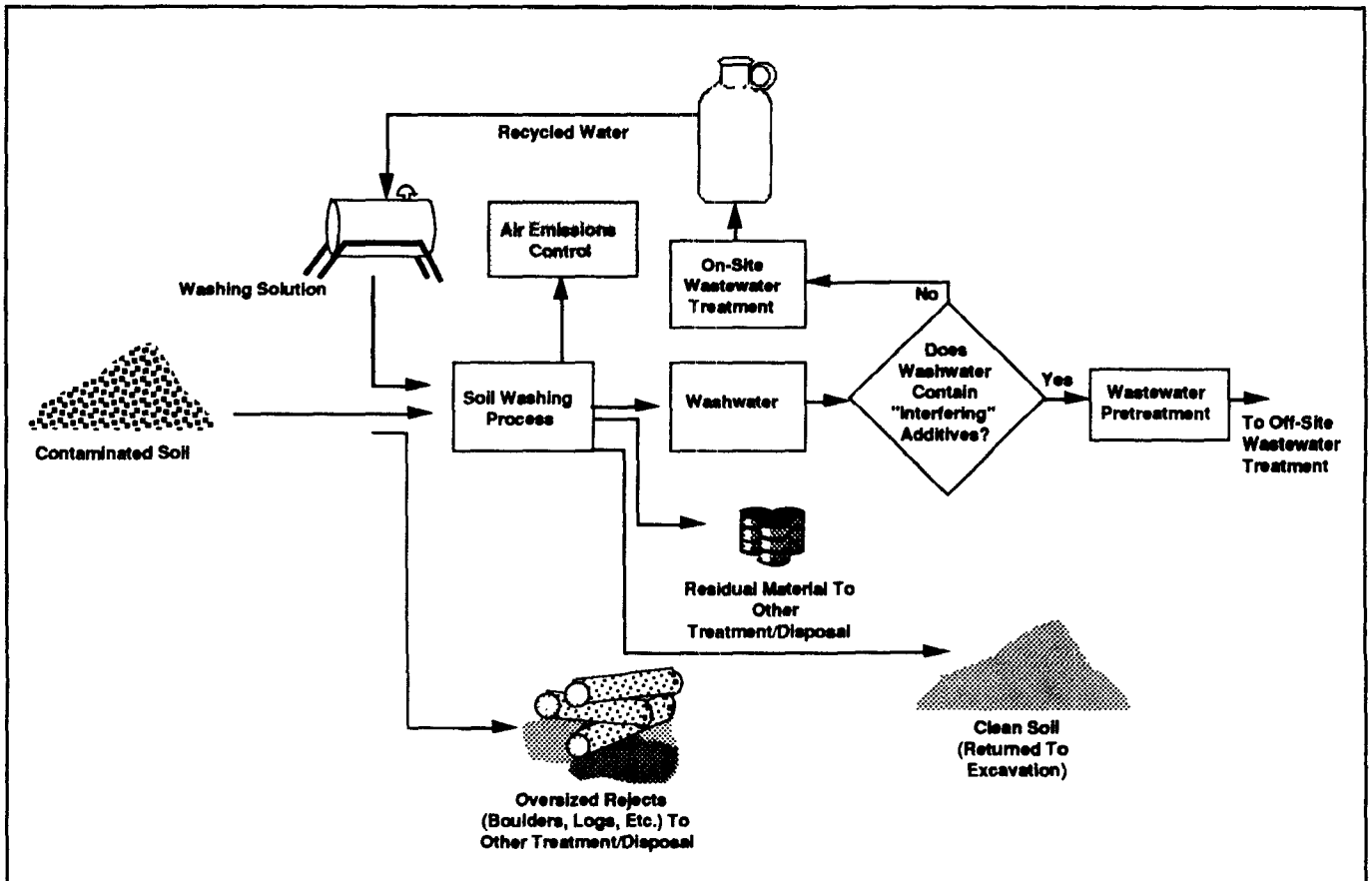
What Is Soil Made Of?

Soil is comprised of fine-grained (silt and clay) and coarse-grained (sand and gravel) particles, organic material (decayed plant and animal matter), water, and air. Contaminants tend to readily bind, chemically or physically, to silt, clay, and organic material. Silt, clay, and organic material, in turn, bind physically to sand and gravel. When the soil contains a large amount of clay and organic material, the contaminants attach more easily to the soil and, therefore, are more difficult to remove than when a small amount of clay and organic material is present.

The contaminated silt and clay in the washwater settle out and are then separated from the washwater. The washwater, which now also contains contaminants, is treated by wastewater treatment processes so it can be recycled for further use. As mentioned earlier, the washwater may contain additives, some of which may interfere with the wastewater treatment process. If this is the case, then the additives must be removed or neutralized by "pretreatment" methods before the washwater goes to wastewater treatment.

Once separated from the washwater, the silts and clays are tested for contaminants. If clean, this material can be used on the site or taken elsewhere for backfill. If contaminated, the material may be run through the soil washing process again, or collected for alternate treatment or off-site disposal in a permitted RCRA or TSCA landfill.

Figure 1
Simplified Soil Washing Process Flow



Any air emissions that may be created during the soil washing process are collected and treated to meet applicable regulatory standards.

Why Consider Soil Washing?

Soil washing can be used as a technology by itself but is most likely to be used in combination with other treatment technologies.

Soil washing reduces the volume of the contaminated material but does not reduce the toxicity of the contaminants. When combined with other treatment technologies, the toxicity of the contaminants can be reduced. The larger scale soil washing equipment presently in use can process up to 25 tons of soil per hour.

In general, soil washing is most effective on coarse sand and gravel and may treat a wide range of contaminants, such as heavy metals, gasoline and fuel oils, and pesticides. There are several advantages to using this technology. Soil washing:

- Provides a closed system that remains unaffected by external conditions. This system permits control of the conditions (such as the pH level and temperature) which surround the soil particles being treated.
- Allows hazardous wastes to be excavated and treated on-site.
- Can significantly reduce the volume of the contaminated soil that requires further treatment.
- Has the potential to remove a wide variety of chemical contaminants from soils.
- Is cost-effective because it can be employed as a pre-processing step in reducing the quantity of material to be treated by another technology. It also creates a more uniform material for subsequent treatment technologies.

Will Soil Washing Work At Every Site?

Soil washing works best when the soil does not contain a large amount of silt and clay. In some cases soil washing is best applied as a technology in combination with other treatment technologies, rather than as a technology by itself.

Removal of contaminants can often be improved during the soil washing process by adding chemical additives to the washwater. However, the presence of these additives may cause some difficulty in the treatment of the used wastewater and the disposal of residuals from the washing process. Costs of handling and managing the additives have to be weighed against the amount of improvements in the soil washing process's performance.

What Is An Innovative Treatment Technology?

***Treatment* technologies are processes applied to the treatment of hazardous waste or contaminated materials to permanently alter their condition through chemical, biological, or physical means. Technologies that have been tested, selected or used for treatment of hazardous waste or contaminated materials but lack well-documented cost and performance data under a variety of operating conditions are called *innovative* treatment technologies.**

Where Is Soil Washing Being Used?

Soil washing has been used at waste sites in Europe, especially in Germany, the Netherlands, and Belgium. In the United States, soil washing has been selected at numerous Superfund sites. Table 1 lists some Superfund sites where soil washing has been selected, their location and types of facilities requiring treatment.

Table 1
Site Locations Where Soil Washing Has Been Selected *

Site	Location	Type of Facility
Arkwood	Arkansas	Wood preserving
Cabot/Koppers	Florida	Wood treating and pine tar distillation
Cape Fear Wood Preserving	North Carolina	Wood preserving
Coleman-Evans Wood Preserving	Florida	Wood preserving
Ewan Property	New Jersey	Industrial waste dumping
G.E. Wiring Devices	Puerto Rico	Wiring services
King of Prussia	New Jersey	Recycling
Koppers (Oroville Plant)	California	Wood preserving
Koppers/Texarkana	Texas	Wood preserving
Moss American	Wisconsin	Wood preserving
Myers Property	New Jersey	Pesticide manufacturing
Sand Creek Industrial	Colorado	Refinery, pesticide manufacturing, and landfill
South Cavalcade Street	Texas	Wood preserving and coal tar distillation
United Scrap Lead	Ohio	Lead battery recycling
Vineland Chemical	New Jersey	Pesticide manufacturing

* All waste types and site conditions are not similar. Each site must be individually investigated and tested. Engineering and scientific judgment must be used to determine if a technology is appropriate for a site.

For More Information

EPA prepared this fact sheet to provide basic information on soil washing. Additional technical reports are listed below. The documents containing a "PB" designation are available by contacting the National Technical Information Service (NTIS) at 1-800-336-4700. Mail orders can be sent to:

National Technical Information Service
Springfield, VA 22161

Documents containing EPA numbers can be ordered by calling (513) 569-7562 or writing to:

Center for Environmental Research Information
26 West Martin Luther King Drive
Cincinnati, OH 45268

There may be a charge for these documents.

- **Handbook on In Situ Treatment of Hazardous Waste - Contaminated Soils, EPA/540/2-90/002; PB90-155607.**
- **Innovative Technology: Soil Washing; OSWER Directive 9200.5-250-FS, PB90-274184.**
- **Mobile System for Extracting Spilled Hazardous Materials from Soil (Fact Sheet available from Risk Reduction Engineering Laboratory, Releases Control Branch, Edison, NJ 08837, (908) 321-6926.)**
- **Mobile Volume Reduction Unit for Washing Contaminated Soil (Fact Sheet available from Risk Reduction Engineering Laboratory, Releases Control Branch, Edison, NJ 08837, (908) 321-6926.)**
- **Overview/Soils Washing Technologies for CERCLA, RCRA, and LUST Site Remediation (available from Risk Reduction Engineering Laboratory, Releases Control Branch, Edison, NJ 08837, (908) 321-6625.)**
- **Engineering Bulletin: Soil Washing Treatment, EPA/540/2-90/017.**
- **Field Studies of In Situ Soil Washing, EPA/600/52-87-110.**
- **Nunno, T.J. and J.A. Hyman, Assessment of International Technologies for Superfund Applications, EPA 540/2-88/003; PB90-106428.**
- **Selected Alternative and Innovative Treatment Technologies for Corrective Action and Site Remediation, EPA/540/8-91/006.**

*U.S. Government Printing Office: 1992 — 648-080/60003